Center Innovation Fund: JSC CIF

Super Micro-Cool: Forced Boiling in a Micro-channel Pumped Fluid Loop

Completed Technology Project (2013 - 2013)

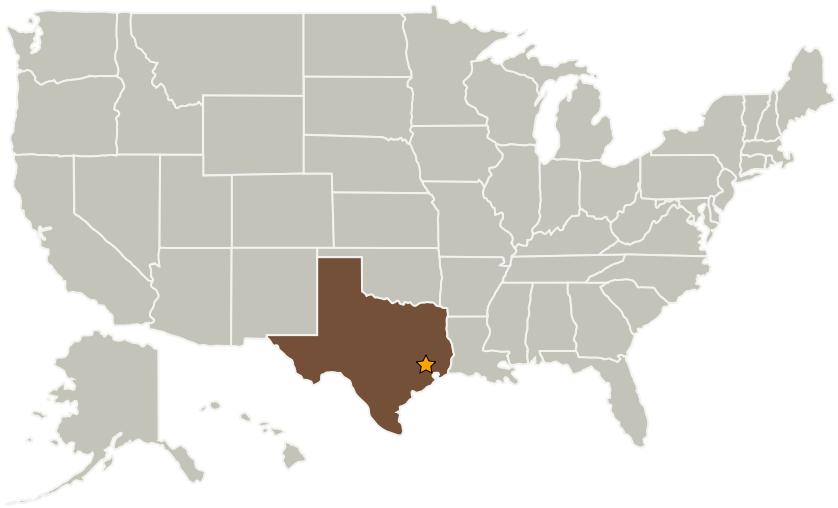
Project Introduction

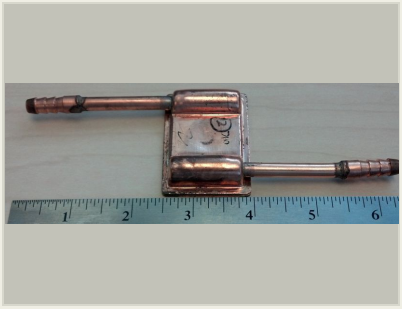
Two-phase heat rejection offers vast potential in reducing the thermal control footprint of vehicles and equipment in terms of mass, volume, and parasitic power loss. This potential follows from the latent heat associated with phase change: in order to remove the same heat as a single phase water loop having a 20C temperature rise, a two-phase loop needs only 5% the flow rate, and consequently 3 orders of magnitude lesser pumping power, while simultaneously providing a constant heat rejection temperature. A key issue in consideration of two-phase, however, is predicting behavior in partial and micro-gravity environments. Recent research indicates that the performance of forced boiling in constrained channels, e.g. micro-channels or micro- heat exchangers, is not affected by the presence or lack of gravity. This is a consequence of a characteristic length scale small enough that surface tension forces dominate flow behavior rather than buoyancy forces which dominate at conventional scales. This project proposes to demonstrate a pumped two-phase cooling loop, e.g. one that collects heat from heat sources through forced micro-channel boiling, mitigating unknowns of microgravity boiling, and does not employ a compressed vapor phase.

Anticipated Benefits

Two-phase pumped loops have many strong benefits in cooling applications outside of NASA, particularly in modern cloud computing server farms and rack cooling where the low flow rate and parallel placement of a vast number of two-phase micro coldplates can be leveraged for considerable cooling power reductions.

Primary U.S. Work Locations and Key Partners





Project Image Super Micro-Cool: Forced Boiling in a Micro-channel Pumped Fluid Loop

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Organizations Performing Work	Role	Type	Location
★Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations
Texas

Images

12134-1376956736096.jpg
Project Image Super Micro-Cool: Forced Boiling in a Micro-channel Pumped Fluid Loop
(https://techport.nasa.gov/image/2231)

Links

NTR 1
(http://MSC-25703-1)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Center / Facility:
Johnson Space Center (JSC)

Responsible Program:
Center Innovation Fund: JSC CIF

Project Management

Program Director:
Michael R Lapointe

Program Manager:
Carlos H Westhelle

Project Manager:
Thomas J Cognata

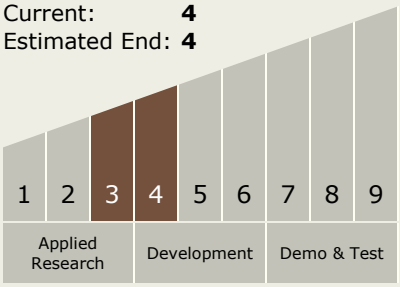
Principal Investigator:
Thomas J Cognata

Super Micro-Cool: Forced Boiling in a Micro-channel Pumped Fluid Loop

Completed Technology Project (2013 - 2013)

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.2 Thermal Control Components and Systems
    - TX14.2.2 Heat Transport